

A NEW ADMIXTURE
OF
COMMERCIAL STROPHANTHUS SEED

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Towards the latter end of January of the present year, there appeared on the market, under the designation "Mandala Brand," a small consignment of *strophanthus* seeds from East Africa. These seeds were loose and freed from their awns. A good proportion of them was found to answer perfectly the description of the official seed. Admixed with this, however, were slightly smaller seeds of a brownish tint, which could be easily *picked out by hand* from the sample. My attention was kindly directed to these seeds by Mr. E. M. Holmes, F.L.S., who pointed out that there was, in the Museum of the Pharmaceutical Society of Great Britain, a complete botanical specimen of a hitherto undescribed variety of *Strophanthus Courmonti*, Sacleux, of East African origin. This plant Mr. Holmes has named *Strophanthus Courmonti*, Sacleux, var. *Kirkii*, and he suggested that it might be the source of the brown seeds recently observed in commerce.

The seeds contained in the pod of this specimen were found to agree, on casual inspection, in shape and size with the brown "Mandala" kind, but to be more hairy. Subsequent more detailed

* Read at a meeting of the Pharmaceutical Society, held in London on Tuesday, April 23, 1901, and reprinted from the *Pharmaceutical Journal*, April 27, 1901.

examination has convinced me that they are identical,* and that the smoother appearance of the commercial sample is due to loss of hairs by friction.

It was thought that the question was of sufficient importance to justify a systematic comparison of the characters of the new admixture with those of the official seed, and this I have endeavoured to do. I have not attempted to give a complete description of these seeds, but have taken the official seed as a type, and compared those at present under examination with it. All differences which I observed, however slight they may be, will be noticed, while those that I consider to be of diagnostic importance will be stated in detail and subsequently summarised.

Seven of the commercial seeds are shown in Fig. 1, and six from the pod referred to, in Fig. 2. They agree quite well in size and shape, but those from the pod differ from the others by being completely covered with hairs. The seeds from the commercial sample do possess hairs, however, and some more than others; it is also quite easy to observe that these hairs are not limited to any definite portion of the seeds, but may be found in irregular patches, in any position. Such a condition of things points to the conclusion that hairs were originally present over the whole of their surfaces, and this conclusion is confirmed by microscopical observation, in that the scars left by the hairs on the outer walls of the epidermal cells are generally apparent.

These seeds have a greater tendency to a lanceolate form than the official ones. They are also smaller in size, on the average; thus, in length, I have found the extremes to be 8 Mm. and 14 Mm. respectively, the extremes in width 2·5 Mm. and 3·5 Mm., and those in thickness 1 Mm. and 2 Mm. Such extremes in *thickness*, however, are exceptional, the average (1·5 Mm.) being, usually, only slightly deviated from.

The colour of all these seeds is decidedly brown, whether they

* The description of the seeds of *S. Schuchardti*, Pax, as given by Dr. Payrau in his thesis ('Recherches sur les *Strophanthus*,' par Vincent Payrau, Docteur en Pharmacie de l'Université de Paris, Paris, 1900), agrees closely with that given here, but differs from the latter in the following particulars:—Form of the seeds obtuse, their base rounded. The section of the lateral thickenings on the external portion of the integuments is a circle, about 8μ in diameter, pp. 99 and 100, *loc. cit.* This species, moreover, has only been found, so far as I am aware, in Western tropical Africa. The short description given by the same author of *S. Courmonti*, Sacleux, also agrees fairly well, as far as it goes, with the present one. The colour of the seeds is described as grey-brown, and the section of the lateral walls of the epidermal cells is stated to have the form of an ellipse whose long axis = 10μ and short axis 7 to 8μ . The smaller size of these seems thus to be the only definite distinguishing feature.

have hairs or not, but the presence or otherwise of the hairs modifies the tint to some extent; thus, if one of the hairy seeds be viewed from below, this brown is golden and sheeny, while in the inverted seeds, or in those deprived of their hairs, it is dull and of a reddish hue; I consider this colour to be a fairly reliable distinguishing feature from the official seeds, judging by my own observations. The statements of others, however, throw some doubts upon its reliability. For instance, Dr. Payrau states that when a certain number of the hairs are wanting in *S. Kombe*,* the seeds are red-brown, and he adds, further, that the colour of the (intact) seeds may be greenish, whitish, or brownish, with all intermediate gradations.†

There can hardly be said to be any distinct ridge on the ventral surface, and it requires a close scrutiny of the intact seed (see Fig. 2) to discover which surface is the ventral one; it is, however, indicated by the fine scar (hilum) left by the funicle or by the remains of the slender funicle itself, and frequently also by a shallow *depression* towards the chalazal end of the raphe (*i.e.*, in the region corresponding to that portion of the ridge which is nearest to the base in the official seed).

In the seeds from which most of the hairs have disappeared, the portion corresponding to this ridge is indicated by a light line towards the apex, and, usually, by a light fusiform patch towards the chalazal end. (See Fig. 1.) The whole, in the great majority of cases, is, practically, level with the surface of the seed, but it may project very slightly towards the apex. This, however, is quite different from the well-marked ridge of the official seed.

The hairs, when present, do not exhibit the arrangement in longitudinal rows to nearly the same extent as in the official seed. The reason for this is probably to be found in the closer attachment of the seed-coats. In Fig. 4 the general average outline of a transverse section of the seed-coats is shown. The figure was sketched from a section cut through the dorsal surface of a commercial seed, about half-way between its apex and base, and mounted in chloral-hydrate. Fig. 3 represents a section of the official seed under precisely the same conditions; it will be seen at once that the sub-epidermal layers are much looser than in

*Prof. Hartwich points out that this is the correct orthography, not "Kombé." 'Einige Bemerkungen über Samen Strophanthi,' von C. Hartwich, Berlin, 1901, p. 3.

† "Quand une certaine quantité de ces poils fait défaut, la graine est alors rouge-brun."

"La couleur peut varier; elle peut être verdâtre, blanchâtre ou brunâtre avec tous les termes de passage." p. 76, *loc. cit.*

Fig. 4, and that the crests and furrows are, in consequence, much more pronounced than in the latter, giving rise thereby to a more evident arrangement of the hairs in longitudinal rows. This accentuation of a wavy outline, in the cross section of the seed-coats of the official seed, is certainly a striking feature when compared with the seeds which I now have under examination. I should hesitate, however, to lay too much stress on this character, inasmuch as a great deal may be made to depend on external factors—such as time of collection, method of drying, and so on.

Turning now to the microscopical characters, we find that the transverse sections of the lateral walls of the epidermal cells do not show, in the generality of cases, any marked differences from those of the official seed. (Figs. 6, 7 and 8.) Even where they are arranged in a slightly undulating manner, we find the same general features obtaining. (Fig. 8.) They have, perhaps, more tendency towards a circular outline, as in Fig. 6, but the difference is much too slight to be of any diagnostic value. Their average height is from 17μ to 19μ , and their average width from 8μ to 10μ . These figures are the mean of 50 measurements, the extreme limits of which are here given:—

(a) For the heights, 25μ and 12.5μ respectively.

(b) „ „ widths, 12.5μ and 7.5μ „

Over the raphe, however, there seems to be a more constant difference, provided that the section be made low enough to pass through the cotyledons. The areas in question, in the official seed, are usually elongated and more or less parallel-sided, as I have elsewhere shown;* here, this is seldom seen. Sections cut too near the apex will not show the difference nearly so well, and it is always advisable to make sure that the cotyledons appear in the section, and not the radicle; this will serve as a rough guide to indicate that the sections are not too near the top.

In longitudinal section, the difference in the general appearance of the majority of the epidermal cells is so obvious as to be at once apparent to the most casual observer. The outer walls, in the official seed, are dome-shaped (Fig. 25), while in those we have under consideration the outer wall is either on the same level as the surface (or nearly so), or depressed below it (Figs. 26 and 27); this is because it is unsupported by the lignified ascending bands of the former.

The hairs are very similar, but the inner surface is not usually so strongly lignified (Figs. 27, 29, 30 and 20) as in the official kind

* *Pharmaceutical Journal* [4], 11, 244.

(Figs. 25 and 21). Annular thickenings are sometimes found (Figs. 23 and 24), while transverse septa (Figs. 28 and 29) not infrequently occur. The lignified portions of the inner surfaces generally thin out towards the base and join on to the upper ends of the lateral hoops of the epidermal cells (Figs. 26, 27 and 29). I have not observed anything more complicated than this, and, in consequence, the hairs are not so firmly attached as in the official seed, and are thus more easily broken off. The slighter development of grooves, affording protection to the hairs placed in them, also contributes to the same end, but I think that the above reason is the principal one.

Passing next to the sub-epidermal portion of the seed-coats, we find that the layers are not capable of so much distension as in the official seed. They resemble the latter closely, however, in other respects, but are well characterised by the great abundance of crystals of calcium oxalate present. (Fig. 7.) These are better seen in a longitudinal section than in a transverse one, but best of all in a surface view. (Fig. 9.) The surface view is, moreover, quite easy to get; it is only necessary to soak a seed in water, or, better still, in weak spirit, over night, when the seed-coats can be detached entire and examined in chloral hydrate.

Various forms of the crystals that occur are shown in Figs. 10 to 19. The majority of them are single, but some are twins (Figs. 10, 11, 17 and 18), presenting, in many cases, the appearance of an open book. (Fig. 11.) The single crystals may occur as rectangular (Fig. 16), lozenge-shaped (Fig. 14), or six-sided (Figs. 12 and 19), plates, or as octahedra, or forms resembling these (Fig. 15), etc.* Cluster crystals are also occasionally seen, but only in extremely small proportion. Prof. Hartwich, who was the first to observe the presence of calcium oxalate crystals in *strophanthus* seeds, did not find them in the seed-coats of *S. hispidus* and *S. Kombe*, and their absence in these two seeds has been corroborated by several observers. Professor Tschirch and Dr. Oesterle, on the contrary, state that well-~~in~~formed crystals exist in the parenchymatous portion of the integuments of *S. Kombe*, especially in the outer layers.†

* All such forms are frequently termed "prismatic crystals," a convenient though hardly accurate, name.

† 'Anatomischer Atlas der Pharmakognosie und Nahrungsmittelkunde,' von Dr. A. Tschirch, und Dr. O. Oesterle, Leipzig, 1900: "Unter der Epidermis folgt dann die Nährschicht. Dieselbe besteht aus zahlreichen Reihen mehr oder weniger obliterierter, zarter Parenchymzellen, von denen besonders die äusseren Reihen bisweilen wohlausgebildete Kristalle führen." p. 337, loc. cit.

I have been led by these conflicting statements to pay special attention to this point, and have to state that calcium oxalate crystals are not completely absent from the seed-coats of any of the strophanthus seeds which I have so far examined; they are very scarce in true *S. hispidus* and in the specimen of the official seed which I investigated last year, having at that time escaped my notice. But even in these I have never found less than a dozen crystals, mostly in the form of clusters, which appear to be almost entirely confined to the extreme base of the seeds, and which would not, therefore, appear in a transverse section, such as that shown in Tschirch and Oesterle's Atlas. I have, however, found a case resembling that described by Tschirch and Oesterle in the seeds from one of the earlier consignments of the "Kombe" drug, imported by Messrs. Burroughs, Wellcome and Co. from Nyassaland. Here crystals may be found sparsely distributed throughout the whole of the sub-epidermal layers of the seed-coats, where they occur mostly as clusters, thereby differing from those observed by the two above-mentioned workers. These seeds, by-the-way, are in the original pods,* and conform quite well to the official description.

Notwithstanding the fact that calcium oxalate crystals occur in the official seed, I consider that the rarity of their occurrence, as contrasted with their great abundance in the present seeds, constitutes a character of diagnostic importance.

The space occupied by the vessels of the raphe is, as was to be expected, less bulky than in the official seed.

The albumen (endosperm) and the embryo call for little comment. The outer walls of the cells of the external layer in the former are not infrequently distinctly creased (Fig. 22), while the remaining cells are, perhaps, rather thicker-walled than in the official seed. This feature, however, as I have shown previously, is too uncertain to be of any value.†

* There is a sample of these in the Pharmaceutical Society's Museum.

† *Loc. cit.*, p. 265. It is interesting to learn that Dr. Payrau has examined the sample of seeds in which Dr. Blondel found rounded cells with extremely thin walls. He is of opinion that the bodies sketched by Dr. Blondel are oil drops, and not cells at all. "*D'après BLONDEL, l'albumen est formé de cellules arrondies. Nous n'avons pas remarqué qu'il y eût des cellules arrondies, telles qu'il les a dessinées. L'erreur doit, sans doute, venir de ce que les parois sont très minces, et que ces cellules sont occupées par une grosse goutte d'huile.*" p. 79, *loc. cit.* can quite conceive that such a mistake might be made, especially in a preparation cleared with aqueous potash. It must be admitted, however, that Dr. Payrau himself is not quite consistent on this point (the thickness of the cell-walls), for he states on another page (p. 43, *loc. cit.*) that the albumen in strophan-

The seeds from the pod contain no starch; most of those from the commercial sample do—in the albumen at least. The absence or presence of starch in oily seeds depends so much as to whether they are ripe or not, that this would merely indicate that the seeds in the commercial sample are not mature.

With concentrated sulphuric acid, the fine dark-green coloration of the albumen, so evident in the official seed, is not produced, the first coloration to appear being a nondescript tint, which gradually passes into a pale crimson, becoming subsequently deeper, and, finally, of a rich purple hue. In the cotyledons, also, the first tints to be seen are rather indefinite. They are succeeded by a reddish-brown, which gradually becomes more red, and finally ends in a rich purple, as in the albumen. The seed-coats become dark brown at once, and remain so throughout.*

These colours are such as are seen under the low power of the microscope by transmitted light.

The seeds are bitter, but not intensely so.

Summarising the points which are likely to be of value in distinguishing these seeds from the official ones, we have:—

- (1) The smaller average size and more lanceolate shape.
- (2) The distinctly brown colour.
- (3) The absence of a distinct ridge on the ventral surface.
- (4) The absence of dome-shaped outer walls in the longitudinal

thus seeds consists of irregular polygonal cells with thick walls: "*L'albumen . . . est formé de cellules polygonales irrégulières à parois épaisses.*"

A similar inconsistency is to be found in Tschireh and Oesterle's great work, where it is stated in the text that the cells in the endosperm (albumen) are relatively thick-walled: "*Es besteht aus mehreren Reihen relativ dickwandiger Zellen . . .*"—p. 337, *loc. cit.* And they are thus shown in the figures given of the transverse section (Fig. 27, Taf. 78) *loc. cit.*; in the longitudinal section of the same seed, however, they are depicted with much thinner walls (Fig. 25 of the same plate).

† In order to eliminate the "personal equation" as far as possible, I have obtained the opinion of a professional artist on these tints, and append his description.

- (a) At the start.—Albumen, yellow ochre. Cotyledons, brownish yellow.
- (b) After 10 minutes.—Albumen, pale crimson lake. Cotyledons, greenish brown.
- (c) After 20 minutes.—Albumen, crimson lake. Cotyledons, burnt sienna, with a trace of crimson lake, externally; still the same tint as in (b) in the centre.
- (d) After 1 hour.—Albumen, crimson lake. Cotyledons, burnt sienna, with a trace of crimson lake.
- (e) After 1½ hours.—Albumen, purplish-red. Cotyledons, similar.
- (f) After 1½ hours.—General purple colour in both cotyledons and albumen. Seed-coats Vandyke-brown throughout, but rather deeper towards the end,

sections of the epidermal cells, this being due to the absence of lignified ascending bands.

(5) The presence, in great abundance, of "prismatic" crystals of calcium oxalate in the sub-epidermal tissue of the seed-coats.

(6) The absence of a dark green colour in the albumen when a section is treated with concentrated sulphuric acid.

(7) The less intense bitter taste.

In conclusion, it may be useful to call attention to the very complete bibliography of *strophanthus* at the end of Dr. Payrau's thesis.

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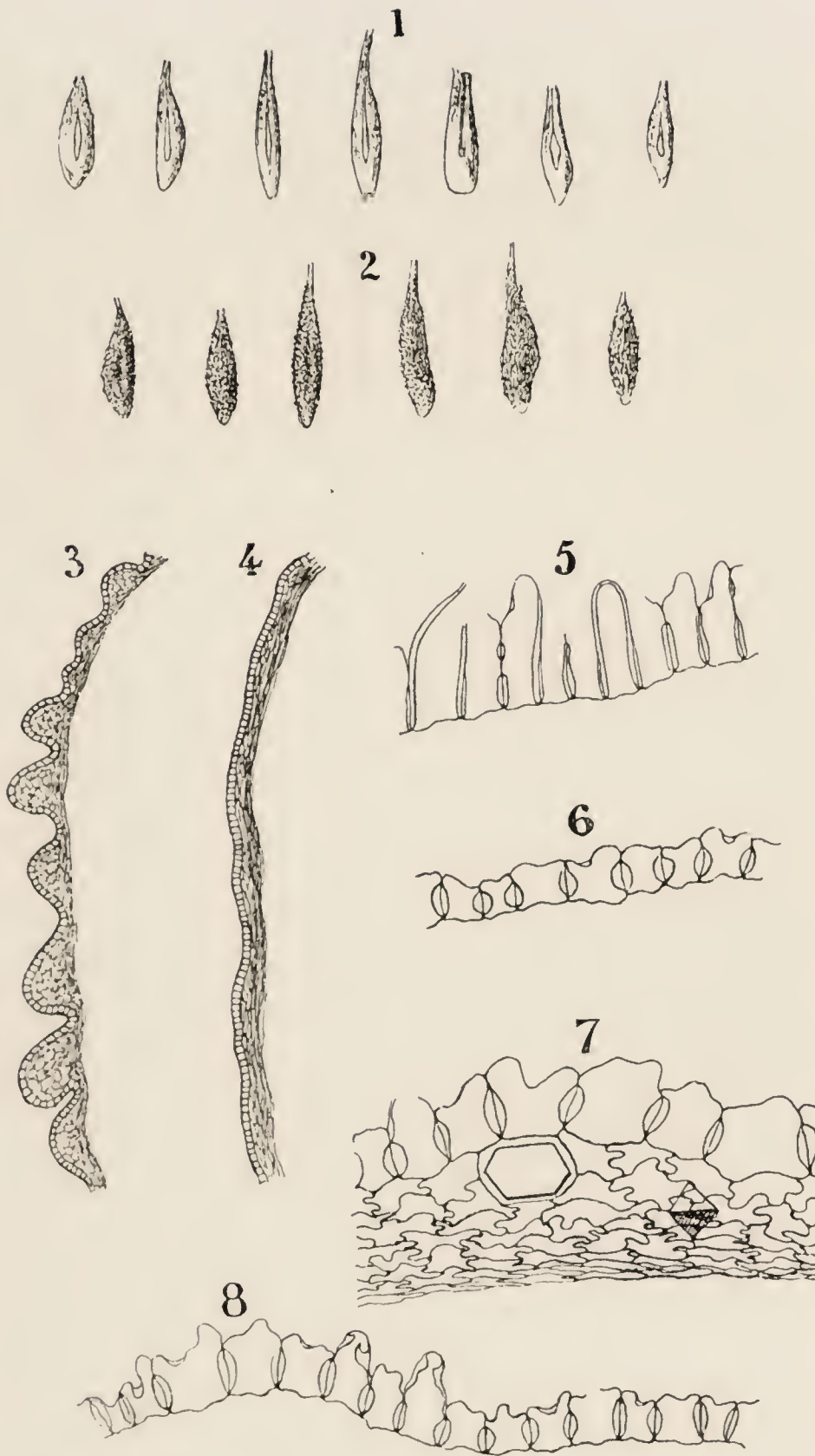


FIG. 1.—Ventral views of seven of the brown commercial seeds. Natural size. FIG. 2.—The same of six seeds from the pod of *S. Courmonti* Sacleux, var. *Kirkii*. Natural size. FIG. 3.—Transverse section through seed-coats of an official seed. Diagrammatic. $\times 30$. FIG. 4.—The same of a brown commercial seed. Diagrammatic. $\times 30$. FIGS. 5, 6, and 8.—Transverse sections through epidermis of seed-coats. FIG. 5 is from the ventral ridge of an official seed. $\times 200$. FIG. 7.—Transverse section through the seed-coats of a brown seed, showing crystals. $\times 200$.

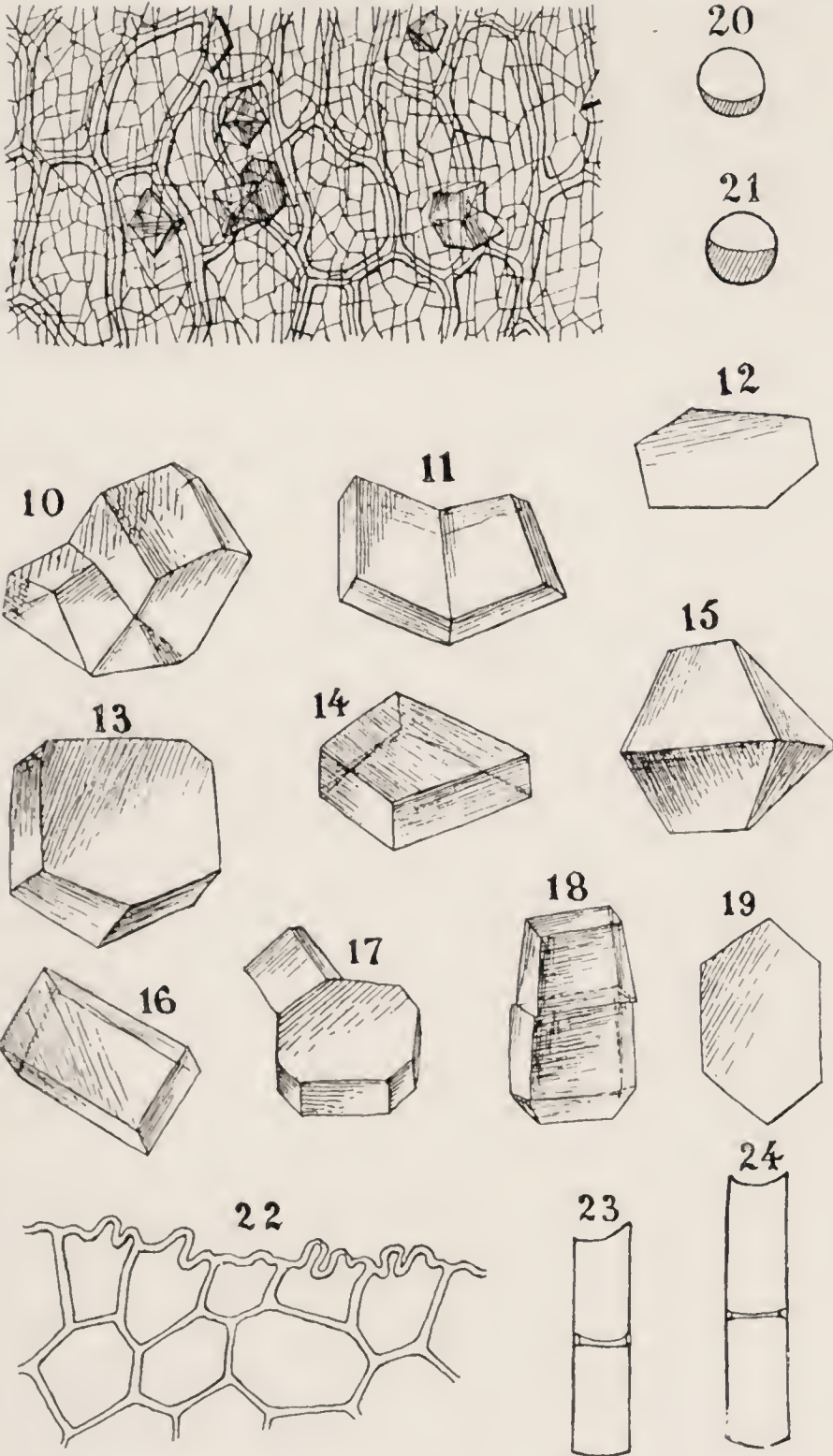


FIG. 9.—Seed-coats seen from the inner surface. $\times 200$. FIGS. 10 to 19.—Various forms of crystals. $\times 500$. FIGS. 20 and 21.—Hairs in transvers section. FIG. 21 is from the official seed. $\times 300$. FIG. 22.—Portion of albumen. $\times 300$. FIGS. 23 and 24.—Fragments of hairs showing annular thickenings. $\times 200$.

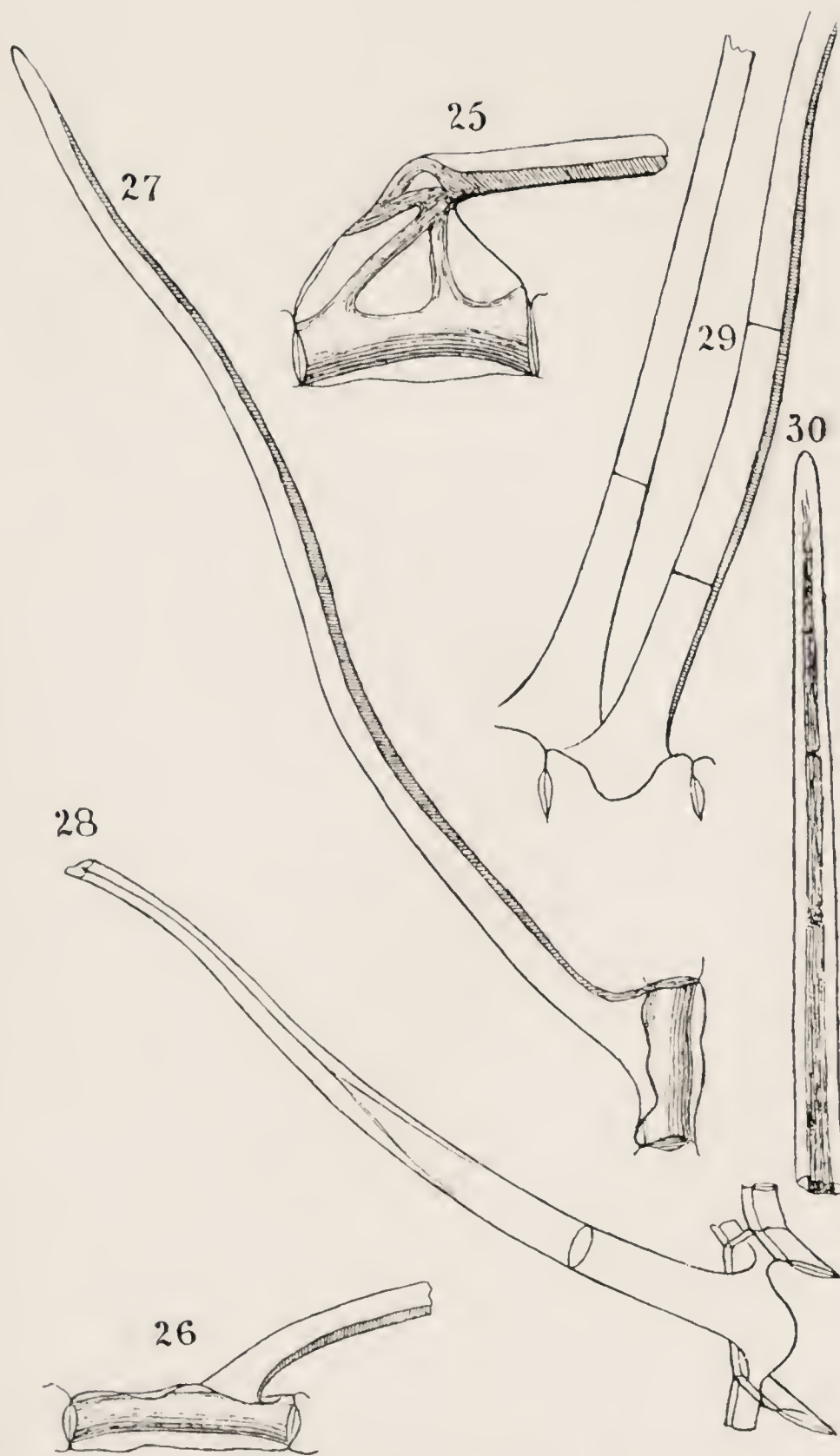


FIG. 25.—Epidermal cell from the official seed. $\times 200$. FIGS. 26 to 29.—Epidermal cells and hairs from the brown seeds. $\times 200$. FIG. 30.—Fragment of hair from same. $\times 200$. FIG. 30 is a surface view, all the other are longitudinal sections.

